
Space Weather Technical Forecast

Issued on Saturday, 30 September 2023 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares throughout. Chance of G1 Minor Storm conditions on day 3 (02 Oct). Active High Energy Electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with mainly low level C-class flares observed. The peak flare was a C9.6 event at 30/1157 UTC from a yet to be determined source. Before this, a C7.5 event at 29/1824 UTC was the peak flare, occurring from an as yet unnumbered region currently at the northeast limb. There are eight sunspot regions on the disc. The most notable is AR3450 in the southeast, which has seen some small growth and has a moderately complex magnetic structure, although it remains a relatively small and inactive region. AR3449, approaching centre disc has remained stable despite a slightly more complex magnetic structure, with mixed polarity intermediate spots. A notable proportion of the recent C-flaring has been focused on two small regions emerging in the northeast, along with visible magnetic looping from a likely region over the northeast limb.

No Earth-directed CMEs have been observed, however a very faint CME was identified from a disappearing solar filament (dsf) around 30/0350 UTC from the southeast disc. This is passing behind (east) and south of Earth.

Solar Wind / Geomagnetic Activity: Solar winds eased from slightly elevated levels to near background. Speeds, as observed by ACE at L1, eased from 450-480km/s to around 380-420 km/s. Density was below average. The interplanetary magnetic field (IMF), Bt, was weak, easing from 8nT to 5nT. The north-south component, Bz, was weakly positive at first, peaking 6nT, then increasingly variable from 29/1930 UTC, before becoming predominately negative from around 30/0430 UTC with minimum -5nT. Phi angle was positive (away from the Sun). Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux rose from Moderate to peak High at 3090 pfu at 29/1455 UTC, then gradually eased back to Moderate by 30/03000 UTC. Associated 24-hour fluence remained rose through the period and above the Active threshold from 30/0600 UTC. The observation at 30/0000 UTC was 8.88e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to remain at Low to Moderate levels, with a chance of isolated M-class flares.

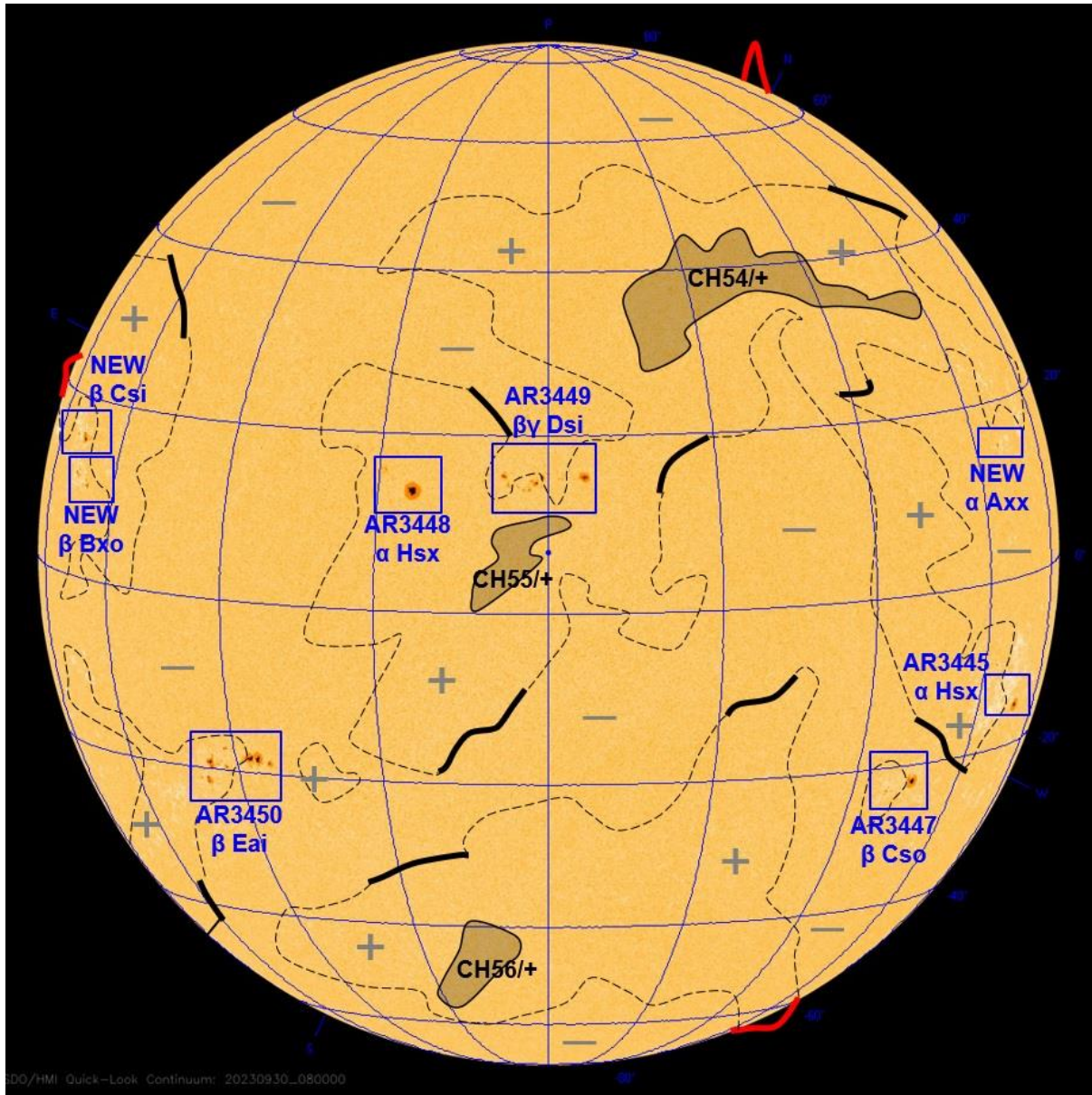
Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. The next notable enhancement is most likely to occur on day 3 (02 Oct) due to the arrival of the fast winds of CH54/-. This feature is currently in the northwest disc, but with a southeastern extended lobe which has a greater potential for a geoeffective connection later in the period. Mainly Quiet geomagnetic activity with isolated Unsettled spells is expected, increasing to Unsettled to Active with a chance of G1 Minor Storms on day 3, before reducing back to mainly Quiet to Unsettled levels on day 4 (03 Oct).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

expected to remain at Background. High energy electron flux (greater than 2MeV) is expected to be Moderate to High, but with a reducing trend in peak values. This likely dropping out to background day 3 (02 Oct) onwards. Active (above $1e8$ integrated pfu) 24 hour fluence day 1 (30 Sep), is expected to ease into day 2 (01 Oct) and likely remaining below this level thereafter.

Figure 1. Solar Analysis Valid 30/0800.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

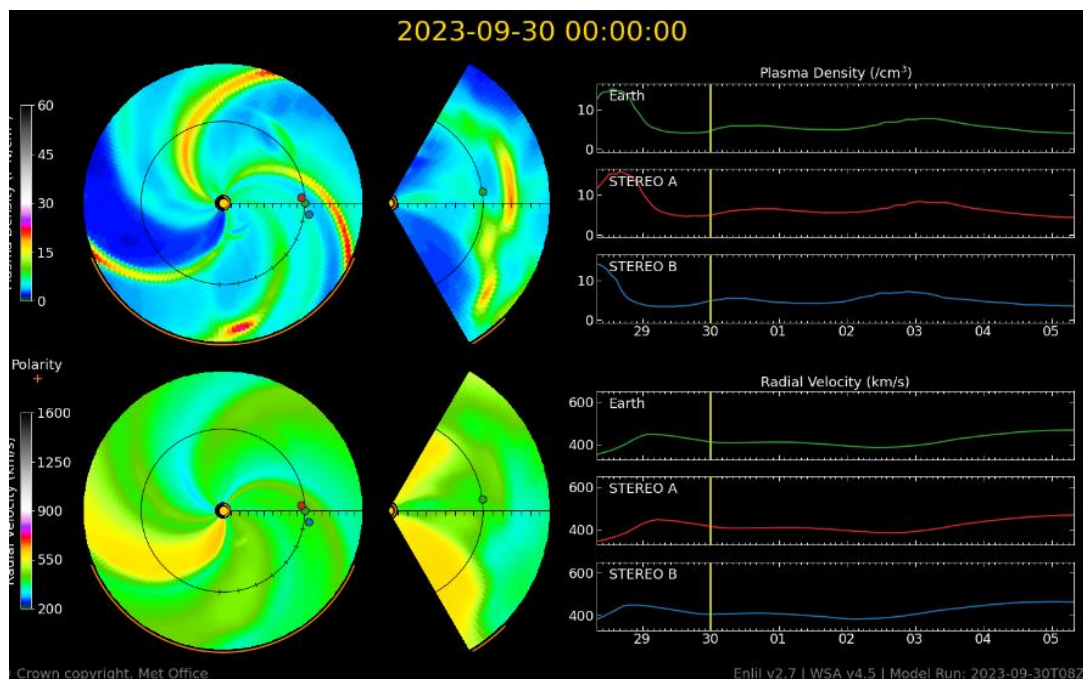
There are no Earth-directed CMEs.

Solar winds are currently at background, with Earth likely south of any notable fast wind influence from CH54+. This is a broad feature in terms of longitudinal extent but at mid-high latitudes across the northwestern disc, although a southeastern extended lobe may allow for a transition into its fast wind on day 3 (02 Oct), perhaps bringing speeds up to around 500 km/s. Considering its positive polarity, this is favoured for a geoeffective connection at this time of year, bringing an increased potential for enhanced geomagnetic activity and is broadly in-line with the current MOSWOC enlil forecast.

Mainly Quiet geomagnetic activity with isolated Unsettled spells is expected until the main enhancement occurs, most likely day 3 (02 Oct). Activity is then expected to increase to be Unsettled to Active with a chance of G1 Minor Storms, before reducing back to mainly Quiet to Unsettled levels on day 4 (03 Oct).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	10	30	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil Model



Radio Blackouts - X-Ray Flares:

Low to Moderate activity is forecast, with a chance for isolated M-flares either from the eight sunspot regions on the visible disc, or from any new region rotating onto the disc from over the northeast limb.

The largest visible group is AR3450 in the southeast, with some ongoing slow flux emergence in its intermediate region however this has been largely inactive with only a simple magnetic structure. AR3450 in the north-centre disc has also remained largely inactive, despite a slightly more complex magnetic field as a beta-gamma spot. The new regions towards the northeast limb have shown the greatest low-level activity with occasional C-flares as they have emerged. However these are currently small regions although further growth is likely.

Some C-flare activity has also been observed over the northeast limb, perhaps suggesting further regions to rotate onto the disc later day 1 or early day 2 (30 Sep-01 Oct).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray Flux



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels, with the current sunspots on the disc considered very unlikely to produce proton events.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	1	1	1	1
Very Active	$\geq \text{S3}^*$	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) observed by GOES16 varied between Moderate and High levels on 29 Sep, and a similar pattern is expected to continue, although with peak flux likely declining through the period. A further drop out is then likely from the onset of any fast winds from CH54/+ on day 3 (02 Oct), although this is low confidence.

The fluence is just above Active levels on day 1 (30 Sep), and is likely to continue at this level into day 2 (01 Oct) but with a decreasing trend, likely falling below Active by day 3 (01 Oct). This is supported by REFM.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV} \geq 1 \times 10^8$	Yes	100	50	10	1
Very Active	$\geq 2 \text{ MeV} \geq 1 \times 10^9$	No	1	1	1	1

Figure 4: GOES 16 >2MeV Electron Flux (top) and associated Fluence with REFM (bottom)

